New Air Traffic Control Tower at Indianapolis Airport
Report In Response to RTI 31402
December 14, 2001

ROC Engineering received RTI 31402 on Dec 8, 2001. The Indianapolis Weather Forecast Office (WFO) contacted the NEXRAD Hotline in Norman, Oklahoma requesting analysis of a new Air Traffic Control Tower (ATCT) being built at the Indianapolis Airport. The new ATCT is expected to be about 9000 feet from the WSR-88D and at least 280 feet tall.

The Indianapolis WFO has two areas of concern: beam blockage and interference at the ATCT. Their questions and ROC Engineering responses are as follows:

1. **How much beam blockage will the new ATCT cause for the WSR-88D?**

The new ATCT is expected to be at a range of 9000 ft (2743 m) with a height of 280 ft (85 m). The Indianapolis WSR-88D antenna is on a 25 m tower. Therefore, the feedhorn of the WSR-88D is approximately 29 m above ground level (AGL).

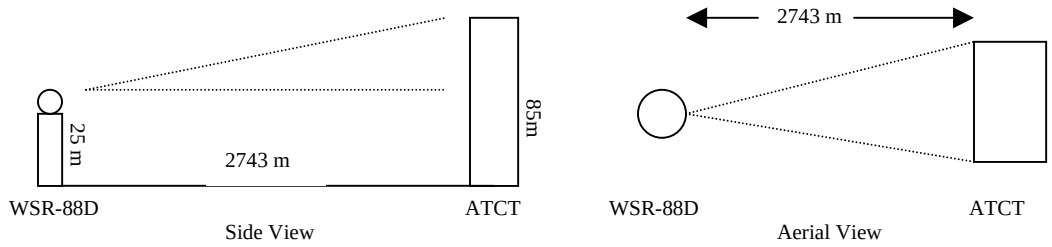

Figure 1 – Side and Aerial diagrams of WSR-88D and ATCT

Assuming the base of the WSR-88D and ATCT are at the same elevation and given the above characteristics for each, the ATCT will extend at least 56 meters above the feed horn of the WSR-88D. At a range of 2743 m, the center of the WSR-88D beam will be above the ATCT at 1.16° of elevation (see figure 1 side view).

No data was provided regarding the width of the ATCT. For this analysis it will be assumed that the ATCT will be a rectangular tower 15 m (50 ft) across at the base. For this width, the tower will subtend .313° of the WSR-88D beam's azimuth (see figure 1 aerial view).

The lowest scan of the WSR-88D is 0.5°. When the WSR-88D is collecting data at this elevation angle, the main beam of the WSR-88D antenna will be blocked (in elevation) to .66° of the antenna bore sight. The ATCT will therefore introduce a total beam blockage bias of –2.26 dB. This beam blockage bias will decrease as the WSR-88D increases its scan elevation. The beam blockage bias is directly inserted into reflectivity and velocity measurements and will decrease their accuracy. In the case of precipitation estimates,

this amount of blockage will degrade rainfall estimates unless properly compensated for in the RDA clutter map. This level of blockage will most likely not significantly impact the velocity estimates and therefore it is unlikely that the Tornado Detection algorithm and Mesocyclone algorithm will be impacted. Attached to the end of this response is a summary of the impact by Tim O'Bannon from the ROC Applications Branch.

2. **At a range of 9000 ft, will the equipment within the ATCT be susceptible to interference?**

The characteristics of the KIND WSR-88D are:

Transmitter Power	750kW (typical)
Microwave Losses (Transmitter to Antenna)	2 dB (typical)
Frequency	2890 MHz
Antenna Gain	45.84 dB
Transmitter Duty Cycle (Short pulse, PRF 5)	.0015912

The peak power density present at the ATCT is then calculated via the radar equation to be 19.2 mW/cm^2. Considering the transmitter duty cycle, the power density becomes .030 mW/cm^2. This is 33 times below the FCC general population Maximum Permissible Exposure Limit (MPEL) of 1 mW/cm^2. Additionally, this is 166 times below the FCC occupational MPEL of 5 mW/cm^2. It most also be noted that this assumes a stationary antenna pointed at the ATCT. During normal operations, the WSR-88D will spotlight the tower at most every 18 seconds. For this reason, there should be no risk to personnel within the ATCT.

The peak power density calculated above translates into a field intensity of 269 V/m. This is 5 times the MIL-STD-461D RS103 bulk cable interference standard of 50 V/m. Therefore, there is a risk of bulk cable interference in the cab of the ATCT.

Summary

1. The proposed ATCT at the Indianapolis airport will impact rainfall estimates unless properly compensated for. It is not expected to have a significant effect on velocity estimates.
2. Radiation at the ATCT caused by the WSR-88D is well below the FCC Maximum Permissible Exposure Level for occupational and general population environments.
3. There is a potential for bulk cable interference at the ATCT caused by radiation from the WSR-88D.

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Response from Tim O'Bannon, ROC Applications Branch, regarding effect of blockage on meterological products.

Subject: Re: New ATC Tower at Indianapolis
Date: Fri, 21 Dec 2001 09:24:07 -0600
From: "Tim D O'Bannon" <Tim.D.O'Bannon@noaa.gov>
Organization: US DOC/NOAA/NWS/NEXRAD OSF
To: Ronald G Fehlen <Ronald.G.Fehlen@noaa.gov>
CC: Andy White <Andy.White@noaa.gov>, Dale Sirmans <Dale.Sirmans@noaa.gov>
References: 1

Ron,

Sorry to take so long getting back to you. I read your report and found it thorough and informative. I've got a couple of comments about the summary. I believe the tower might impact the meteorological algorithm, particularly the Precipitation Processing Subsystem (PPS), the Tornado Detection Algorithm (TDA), and the Mesocyclone algorithm (MESO).

For the PPS, the tower could block a radial of data at the first and second tilts by more than 2 dB. This could cause a wedge in the PPS where the rainfall is underestimated by more than 30%. If you know the precise latitude/longitude of the towrer (and width if you can get it), or the precise azimuthal extents, we can modify a blockage file to compensate for the blockage.

It is far less likely that the tower will caues TDA and MESO problems. The blockage alone shouldn't cause any serious errors in the Doppler velocity data. But depending on the orientation and shape of the tower, reflected echoes from other storms or clutter targets could cause a wedge of erroneous velocity data that could cause false TDA and/or MESO signatures. I don't think we should worry too much, we can take a look at the products after the tower is installed and work with the Indianapolis staff to interpret the results.